

REMARKS

By way of summary, claims 1, 8, 10, 16, 24 and 36 have been cancelled from the present application. Claims 2-7, 9, 11-15, 17-23, 25-35 and 37-51 are claims presently under consideration by the Examiner prior to this Preliminary Amendment. Also, by the present Preliminary Amendment, claims 52-61 have been added to the present application.

Claims 2-7, 9, 11-15, 17-23, 25-35 and 37-51 have been rejected by the Examiner under 35 USC 103(a) as being unpatentable over Luciani et al., EP 0480435 (hereinafter Luciani I). Claims 2-7, 9, 11-15, 17-23, 25-35 and 37-51 have been rejected by the Examiner under 35 USC 103(a) as being unpatentable over Luciani et al., EP 0522651 (hereinafter Luciani II). Claims 2-7, 9, 11-15, 17-23, 25-35 and 37-51 are rejected by the Examiner under 35 USC 103(a) as being unpatentable over WO 91108239 (hereinafter Neste). These rejections are respectfully traversed.

The present invention is directed to a process for producing a solid catalyst component used in the polymerization or copolymerization of olefins, for example, ethylene, as well as a solid catalyst component per se and a process for the polymerization or copolymerization of a polyolefin such as polyethylene using such a solid catalyst. The composition of the catalyst of the present invention which contains Ti, Mg, Cl alkoxy groups and organometallic compounds and the use of non-polar organic solvents to impregnate the particular silica, defines a catalyst system having a different behavior which, in turn produces a different final product in the polyolefin polymerization and copolymerization process. That is, because the present process utilizes a specific amount of titanium, a specific amount of magnesium and a specific amount of chlorine which remains fixed on the solid catalyst component and because of the use of inert organic solvents (non-polar solvents), it is possible to produce particles of homo and copolymers of olefins, for example ethylene, with controlled morphology having high bulk density and contain a very small quantity of binds. The catalyst system of the present invention is also effective in achieving good co-monomer insertion into the final product as well as an improved catalyst activity with low catalytic decay.

Catalyst systems currently being used in polymerization processes are based on the use of a magnesium dichloride support with titanium sites deposited on the support which is a very high activity catalyst in LLDPE copolymerization. As known in the state of the art, this kind of support produces a catalyst with a high degree multiplicity of titanium sites and because of this fact, the comonomer response LLDPE copolymerization is heterogeneous. This heterogeneous behavior is due to the fact that the titanium sites have a different steric and an electronic neighborhood. This heterogeneity is reflected on the higher xylene soluble fraction which is generated when the LLDPE is produced. With the intention of getting more homogeneity of the titanium sites and, consequently, better comonomer response, Luciani I and Luciani II added a compound to the process known as a donor or electron donor compound. This donor was added in the catalyst synthesis or during the polymerization and acts as a selective poison for some of the titanium sites. The way it acts is based on Lewis Theory (G.N. Lewis, 1923), which says that in acid-base reactions "bases donate pairs of electrons and acids accept pairs of electrons". In Luciani I and Luciani II, an aromatic or aliphatic ester is used for a solution preparation of magnesium and titanium compounds. In this case both magnesium and titanium compounds used in the solution preparation act as Lewis acids and the ester, which has oxygen groups, acts as a Lewis base. When this solution is deposited over an inert support, part of this donor remains bonded to the titanium or magnesium sites. This kind of selectivity poisoning of titanium or magnesium sites affects the behavior thereof during copolymerization generating more homogeneous sites. This higher homogeneity of the sites, consequently, affects the xylene soluble fraction content which becomes smaller during the copolymerization. Examples of Lewis acids are titanium and magnesium compounds and of Lewis bases are compounds with oxygen, nitrogen groups (water, ester, ether, amines, etc.) which have extra electrons to donate.

As can be seen by referring to the present application, no electron donor or donor is used, as detailed in the Summary of the Invention, in the Detailed Description and in the Claims. In the present invention, the homogeneity of the sites of the solid catalyst component is reached through the amounts of components present in the solid catalyst and in the fact that no donor or electron donor is used during the solid catalyst component preparation.

Table 1 compares the amounts of Ti, Mg, and Cl present in the catalyst system of the present invention with that of Luciani I, Luciani II and Neste.

TABLE 1 – Elemental ranges

	Present Application	EP 0480435 B1 (Luciani I)	EP 0522651 B1 (Luciani II)	WO 91/08239 (Neste)
Ti range (% w/w)	0.5 – 2.0	3,9 – 4,5	3.7 – 4.4	3.2 – 4.9
Mg range (% w/w)	0.3 – 3.0	2,7 – 5,0	3.4 – 3.9	0.70 – 1.75
Cl range (% w/w)	5.0 – 12.0	17,7 – 21,0	12.4 – 19.7	12.2 – 22.5

The important aspect regarding the elemental ranges (Table 1) is that in Luciani I, Luciani II and Neste, the Ti amount is very high and to activate these sites it is usual to use a high amount of the cocatalyst which is usually an aluminum alkyl. This aluminum alkyl acts, in this case, as a Lewis acid and can remove from Ti and also from Mg sites, any donor or electron donor compound, beyond its function as reducing and alkylating agent. In both Luciani I and Luciani II patents they use a donor or electron donor as a solvent for the titanium and magnesium solution. The remaining donor at the final catalyst can be removed by this aluminum alkyl, during the polymerization. One of the reasons to use a donor, as mentioned before, is to obtain homogeneity on titanium sites and, consequently, obtain fewer sites which produce the xylene soluble fraction in LLDPE. Consequently, when the catalyst has a high amount of titanium sites, the comonomer response is not as good as that of the present invention which uses a catalyst with a very small amount of titanium. Table 2 below demonstrates a comparison between examples from Luciani I, Luciani II and Neste and an example of the catalyst of the present invention, used in copolymerization of ethylene and butene-1 to produce a LLDPE product. The examples from Luciani I, Luciani II and Neste were reproduced in the lab and used in copolymerization, as shown in Table 2.

TABLE 2

Comparative Test Number	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	TEST 6	TEST 7
Product	LLDPE	LLDPE	LLDPE	LLDPE	LLDPE	LLDPE	LLDPE
Catalyst from	EP 0522651 B1 patent (Example 1)	EP 0522651 B1 patent (Example 4)	EP 0480435 B1 patent (Example 3)	EP 0522651 B1 patent (Example 1)	WO 91/08239 patent (Example 10)	WO 91/08239 patent (Example 10)	Present Application (Example 8)
Ti (%w/w)	6.8	5.2	5.6	6.8	3.9	3.9	2.0
Mg (%w/w)	2.7	3.4	2.3	2.7	0.8	0.8	1.5
Aluminum alkyl	TEAL	TEAL	TEAL	TEAL	TEAL	TEAL	TEAL
Ethylene partial pressure (bar)	5	5	5	5	5	5	5
Temperature (°C)	75	75	75	75	75	75	75
Time (h)	3	3	3	3	3	3	3
Al/Ti	300	300	300	300	300	300	300
Butene-1 (L)	0.29	0.29	0.29	0.70	0.29	0.70	0.29
H ₂ /C ₂ molar ratio	0.47	0.47	0.40	0.40	0.47	0.40	0.40
Bulk Density (g/cm ³)	0.26	0.30	0.27	0.29	0.30	0.31	0.36
MFI (2,16) (g/10)	1.00	1.30	0.40	1.34	0.29	1.25	0.91
Butene content (% w/w)	5.7	6.7	4.7	9.7	5.5	N.A.	8.7
Density (g/cm ³)	0.938	0.925	0.928	0.918	0.925	0.923	0.917
Xylene soluble (% w/w)	5.3	7.3	6.9	14.2	3.0	5.2	9.7

N.A. = not analyzed

The copolymerization condition to specify a LLDPE product, with MIE close to 0.8 - 1.3 g/10 min range and a density close to 0.9170-0.9190 g/cm³, for catalyst Example 8 of the present invention is demonstrated in Test 7 of Table 2 (see the description of polymerization conditions on Example 12 of the present application). It can be seen in Table 2, that this copolymerization condition was the same for all Tests with the exception of Tests 4 and 6, where a higher amount

of butene-1 was used (0.70 L). It can be seen from Table 2 that, using the same conditions of Test 7, from the present application, neither catalysts from Test 1, 2, 3 nor 5 showed a LLDPE product with a Density close to that obtained in Test 7. To obtain the same range of MIE of LLDPE obtained in Test 7, it was necessary to have a higher H₂/C₂= molar ratio for Tests 1, 2 and 5. To obtain a LLDPE product with a density closer to that shown in the Test 7, it was necessary to use higher amounts of butene-1 during the copolymerization, as can be seen in Test 4. For the catalyst example from Neste, it was not possible to obtain a density between 0.9170-0.9190 g/cm³, with the amount of 0.70 L of butene-1, as can be seen in Test 6.

In all of these products the xylene soluble fraction was analyzed. When the same kind of product is compared for Tests 4 and 7 (LLDPE with the same MIE and Density ranges), it can be seen that the xylene soluble fraction is quite different (14.2 and 9.7 % w/w, respectively). These different xylene soluble fraction results are due to the following facts:

1- High amount of Titanium: to activate these sites it is usual to use a high amount of the cocatalyst which is usually an aluminum alkyl. This aluminum alkyl acts, in this case, as a Lewis acid and can remove from Ti (and also from Mg sites), any donor or electron donor compound - in Luciani I and Luciani II a donor or electron donor is used as a solvent for the titanium and magnesium solution.

2- Low amount of Ti and Mg in the present invention - the smaller xylene soluble fraction is due to the lower amount of titanium and magnesium relative to the silica support and the ratio between titanium and magnesium compounds used.

In view of the above remarks, it is believed to be clear that the present invention for all the reasons set forth hereinabove is clearly patentably distinguishable over Luciani I, Luciani II and/or Neste either alone or in combination. If necessary, and at the request of the Examiner, the Applicants are willing to submit the information shown in Table 2 above in the form of a declaration under 35 USC 132.

In the Examiner's Advisory Action dated May 11, 2007, the Examiner argued that the claims only recite relative amounts of reagents, that is, relative amounts of magnesium, titanium and chlorine. However, as the Examiner will note from the claims of the present application including newly added claims 52-61 recite the amount of titanium, magnesium, and chlorine present in percent by weight, based upon the weight of the catalyst. Thus, it is believed that all of the claims of the present application now recite an inventive contribution which is not recognized by any of the references relied upon by the Examiner, either alone or in combination.

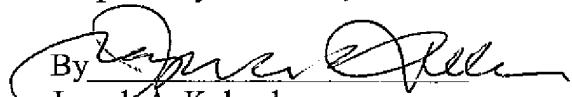
Accordingly, in view of the above amendments and remarks reconsideration of the rejections and allowance of all of the claims of the present application are respectfully requested.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Joseph A. Kolasch, Reg. No. 22,463 at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.14; particularly, extension of time fees.

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Respectfully submitted,

By 
Joseph A. Kolasch

Registration No.: 22,463
BIRCH, STEWART, KOLASCH & BIRCH, LLP
8110 Gatehouse Road
Suite 100 East
P.O. Box 747
Falls Church, Virginia 22040-0747
(703) 205-8000
Attorney for Applicant